OPERATION AND SERVICE MANUAL

350 L BROADBAND POWER AMPLIFIER

ELECTRONIC NAVIGATION INDUSTRIES Inc.

ROCHESTER, NEW YORK, U. S. A.

WARRANTY

Electronic Navigation Industries, Inc. warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing and replacing any defective parts for a period of one (1) year after delivery to the original purchaser.

When warranty service is required, the instrument must be returned transportation charges prepaid to the factory or our authorized service facility. If, in our opinion, the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before work is started.

There are no other warranties expressed or implied, including any warranty of merchantibility or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

FACTORY SERVICE

When Factory Service is required, the following steps should be taken:

(1) Notify ENI, giving full details of the difficulty. Include the instrument's serial number.

(2) Upon receipt of shipping instructions, forward the instrument, transportation prepaid, to the factory or to the authorized repair station indicated on the instructions.

If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

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CHAPTER 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

The ENI Model 350L is an all solid state amplifier which has a flat frequency response from 250 kHz to 105 MHz. It provides 50 watts of linear power with low harmonic and intermodulation distortion. Gain is 50 dB nominal, with a variation of less than $\pm$1.5 dB over the entire frequency range. Input and output impedance are 50 ohms and the unit may be driven to full power output by most RF synthesizers, signal generators and swept signal sources.

The ENI Model 350L will deliver its rated power output into any load impedance, regardless of match. Built-in protection circuitry will absorb the power reflected from a mismatched load without causing failure or oscillation.

Output RF voltage is displayed on the front panel meter. The Model 350L is packaged for bench mounting and is shipped with rack mounting adapters. Its integral power supply and cooling operate from a 115 or 230 VAC 50/60Hz main supply.

The Model 350L will raise the power level of signal sources and generators without requiring tuning or band-switching. The Class A linear circuitry will amplify signals of AM, FM, SSB, TV and complex modulations limited only by their peak input and bandwidth with minimum distortion.

1.2 SPECIFICATIONS

Physical and electrical specifications are listed in table 1-1.

1.3 INSTRUMENT IDENTIFICATION

Each amplifier is identified by a serial number tag on the back panel of the unit. Both the model number and the serial number should be given in any correspondence with the company.

Table 1-1. 350L Specifications

FREQUENCY COVERAGE:	120 kHz to 120 MHz
GAIN:	50 dB nominal
GAIN VARIATION:	±1.5 dB from 250 kHz to 105 MHz
MAXIMUM POWER OUTPUT:	More than 50 watts from 250 kHz to 105 MHz. More than 25 watts from 120 kHz to 250 kHz and 105 MHz to 120 MHz
HARMONIC DISTORTION:	All harmonics 25 dB or more, below fundamental, at 40 watts output; 250 kHz to 105 MHz.
2nd ORDER DISTORTION	More than 30 dB down, at full output
TYPICAL 3rd ORDER INTERMODULATION INTERCEPT POINT:	+56 dBM
INPUT/OUTPUT IMPEDANCE:	50 ohms
INPUT VSWR:	Less than 1.5
OUTPUT VSWR:	Less than 2.0, 250 kHz to 80 MHz; less than 3.0, 80 MHz to 120 MHz (typical)
NOISE FIGURE:	Less than 10 dB
STABILITY:	Unconditionally stable, unit will not oscillate for any condition of load and source impedance
PROTECTION:	Unit will withstand up to 16 dB of overdrive (input signal of 1 volt RMS) for all output load conditions, including short and open circuit loads
OUTPUT METERING:	Average reading voltmeter calibrated in RMS volts for a sine wave, with an accuracy of ±3% of full scale (0-80 volts): also calibrated in watts into 50 ohms (0-120 watts)
POWER REQUIREMENTS:	115/230 VAC ± 10%, 50-60 Hz, 550 watts
OPERATING TEMPERATURE:	0° to +45°C
SIZE:	8-3/4 x 12 x 17 inches
WEIGHT:	42.5 Lbs.
CONNECTORS:	BNC Standard, Type N Optional

CHAPTER 2
PREPARATION

2.1 INITIAL INSPECTION

2.1.1 Mechanical Check

If damage to the shipping carton is evident, request the carriers agent be present when the instrument is unpacked. Check the equipment for damage and inspect the cabinet and panel surfaces for dents and scratches.

2.1.2 Claim for Damage

If the Model 350L is mechanically damaged or fails to meet specifications upon receipt, notify ENI or our representative immediately. Retain shipping carton and packing material for the carriers inspection as well as for subsequent use in returning the unit if necessary.

2.1.3 Performance Check

The electrical performance of the Model 350L should be verified as soon as possible after receipt. The following is a performance check that is suitable for incoming inspection.

a. Check that the 115/230 switch on the rear panel is in the correct position.

b. Set the amplifier front panel power switch to the ON position, and check that the pilot light illuminates and the fan motor is operating normally.

c. Perform RF Output Power Test, section 5.1.4.

2.2 PREPARATION FOR USE

2.2.1 Power Requirements

The Model 350L amplifier requires a power source of 115 or 230 volts AC $\pm$10%, 47 to 63 Hz, single phase, which can supply 550 watts.

The two-position slide switch mounted on the rear panel permits operation from either the 115 or 230 volt power source. The screwdriver slot in the slider must be pushed toward the 115 or 230 volt label depending upon which line voltage is to be connected.

Failure to have the switch in the correct position may result in damage to the instrument. Do not adjust the line-voltage switch when the power cable is connected to the AC line.

2.2.2 Power Cable Ground Protection

To protect operating personnel, the ENI Model 350L is equipped with a three conductor cable and plug which, when inserted in a three terminal receptacle, grounds the panel and cabinet. The offset pin on the power cable three prong-connector is the ground pin. When using a two prong adapter connect the green pigtail on the adapter to ground.

2.2.3 Cooling

When the 350L is enclosed by an external cabinet, provision must be made to insure an adequate flow of cooling air to the unit. Ambient temperature of the air must not exceed 45^{o}C.

2.3 RACK MOUNTING

In order to install the Model 350L in a standard 19 inch relay rack, rack mounting brackets must be attached to the cover, as follows:

a. Remove 6 (six) 8-32 screws from 350L cover just behind the front panel.

b. Verify left and right rack mounting brackets by holding them next to screw holes. Mounting bracket overhang should be at bottom of unit.

c. Attach mounting brackets to sides of unit using same screws and hardware.

d. Tighten all screws carefully, assuring that unit is held firmly in place.

e. The four rubber feet on the bottom plate may be unscrewed and removed if the minimum vertical usage of the relay rack is necessary.

2.4 PACKAGING FOR RESHIPMENT

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the orginal packing material is not available, wrap the instrument

in heavy paper or plastic. Use a strong shipping container. If a cardboard carton is used, it should be at least 200 lb. test material. Use shock absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. A minimum of two inches should be between the instrument and the container wall on each side. Protect the front panel and meter by means of cardboard spacers inserted between the front panel and the shipping carton. Make certain that the instrument cannot move in the container during shipment. Seal the carton with a good grade of shipping tape and mark the container FRAGILE ELECTRONIC INSTRUMENT.

CHAPTER 3

OPERATION

3.1 FUNCTIONAL DESCRIPTION

The ENI Model 350L is a linear Class A amplifier capable of increasing the output of any signal generator, frequency synthesizer, sweep generator or laboratory signal source from 250 kHz to 105 MHz.

Less than 200 millivolts of signal is required from the output of the signal source into the 50 ohm input of the amplifier to extract maximum power output. The output power of the 350L is directly proportional to the input signal and therefore, the attenuator of the signal generator will serve as the attenuator for the overall output.

The Model 350L is completely protected against damage due to load mismatch provided that the input RF level does not exceed 1 volt RMS or 1.4 volts peak. If the attached signal source is capable of generating substantially more than this input voltage, please use caution in adjusting it. The Model 350L will saturate well before the maximum input voltage and there will be no increase in output power at that point.

The 350L is unconditionally stable. Any impedance can be connected to the input and output of the amplifier, without causing oscillation.

The 350L will deliver its rated power to any load impedance regardless of match. Load mismatch will cause RF power to reflect back to the amplifier. The unit is designed to withstand 100 percent reflected power (a pure reactance, open or short circuit load will cause 100 percent reflected power) continuously without damage.

An output meter is provided to indicate the average output voltage (calibrated in RMS) as well as the power output when the unit is connected to a 50 ohm load. Since the meter responds only to average output, the modulation characteristics of the input signal must be taken into account when interpreting the meter readings. For example, the amplifier may be in saturation during the on portion of a pulse yet the meter reading will be low due to the low duty cycle of the pulse input.

3.2 CONTROLS, INDICATORS AND CONNECTORS

Front and rear panel devices are described in table 3-1.

3.3 OPERATING PROCEDURE

Refer to the following procedure as a guide to operating the Model 350L.

a. The input and output are connected via the front panel BNC connectors to the signal source and load respectively.

b. The input signal should be increased gradually while observing the output voltage on the output RF voltmeter. Input signal voltage should never be allowed to exceed 1 volt (RMS) or 1.4 volts (peak).

c. When the Model 350L is connected to a 50 ohm load, the CW power output of the unit may be read directly from the meter scale.

d. When the amplifier is connected to an arbitrary or unknown load impedance, the following procedure will insure low distortion power output.

   1. Disconnect the output load cable from the output BNC connector of the Model 350L.

   2. If the CW output voltage is less than 80 volts RMS, the unit is operating at low distortion regardless of the load impedance.

   3. Reconnect the output of the amplifier to the load.

e. If the output of the amplifier is monitored by a high frequency oscilloscope or spectrum analyzer, the input signal may be increased until the point of maximum undistorted power output is observed.

Table 3-1 Front and Rear Panel Devices

DEVICE	FUNCTION
Power Switch	Throwing toggle to "on" position connects fan and power supply to main power source.
Meter	Indicates output voltage and also power for a 50 ohm load. The meter circuit responds to the average RF voltage and is calibrated in RMS volts for a sine wave. The voltage pick-off is mounted directly behind the front panel at the output connector.
Input Connector	BNC type for connection of the driving generator. Input impedance is 50 ohms. No more than 0.2 volts is required to obtain saturated output. Up to 1.4 volts peak can be applied without causing damage; however, no additional power output can be expected.
Output Connector	BNC type for connection of amplifier output to load.
Fuse	Holder requires 3AG size, slow-blow type fuse. Rating is marked on the rear panel.
Line Cord	Three prong type plug with safety ground pin connected to cabinet.
115/230 Voltage Selector	Slide switch operated by using flat blade screw driver as a key to select available line voltage.

3.4 PRECAUTIONS

a. The Model 350L output is at DC ground potential through the final combining transformer (see schematic diagram Figure 7-2). Therefore, the output should not be directly connected to a load on which there is a DC potential. A series capacitor with the appropriate DC voltage breakdown rating (.1 mfd is the recommended value) should be inserted between the output connector and the load.

b. The input and output of the Model 350L should not be connected together. This will cause oscillation and may damage the input preamplifier.

c. The Model 350L should not remain connected to an antenna when the unit is not in use. If thunderstorms are likely, it would be prudent to earth ground the unit's case.

d. When the input signal voltage of the signal source is unknown, insert an attenuator between it and the Model 350L input.

CHAPTER 4
PRINCIPLES OF OPERATION

4.1 GENERAL

The Model 350L achieves it high level of power output by combining the power outputs of a number of individual transistor amplifiers. The hybrid combining technique permits each amplifier to operate independently of all the others and to supply its power output contribution without regard to the other amplifier stages. This isolation is afforded by ferrite loaded transformer hybrids connected at the input and output of each transistor pair.

Each amplifier module (either power amplifier or preamplifier) is designed to have an input and output impedance of 50 ohms. Therefore, the individual modules can be disconnected and tested independently.

Highly linear Class A transistors are used throughout the amplifier. Their linearity is augmented by negative feedback networks connected to each stage. The high power output transistors have nichrome resistors deposited at their emitter terminals to increase linearity and reliability.

The amplifier is powered by a low noise DC regulator of dissipative design. Over temperature protection is built into the power supply and cooling fan.

4.2 BLOCK DIAGRAM DESCRIPTION

A block diagram of the entire Model 350L is shown in figure 4-1.

Input signal from the front panel BNC connector is fed to the preamplifier module (A22). The preamplifier has four equal amplitude and phase outputs. These are fed via coaxial cables to the inputs of four driver amplifier modules (A1). Each preamplifier channel has an overall gain of 16 dB and a maximum power output of 100 milliwatts. The driver amplifier modules are push-pull units capable of supplying up to 3 watts of output, with 20 dB gain. Signal supplied by each driver amplifier is fed to its respective power amplifier module (A21).

Each power amplifier has a gain of 8 dB and is capable of producing more than 15 watts of power at its output. The combiner module (A23) sums the outputs of the power amplifiers while maintaining isolation between them. RF output signal is fed to the output BNC connector and to the RF voltmeter module (A12). The RF voltmeter module provides a DC signal to the front panel meter, proportional to the output level.

The power distribution 350L-2181 provides cooling and DC power to the entire unit. The regulated power supply is capable of supplying 27.5 volts at a current of 16 amperes.

4.2.1 Preamplifier Module (A22) 350L-4185

The schematic of the preamplifier module is shown in figure 7-1. Input signal is amplified by a low noise transistor stage, Q-1. Its output is split into two equal phase signals by transformer T2 and fed to transistors Q3 and Q4. Signal boost capacitors C6 and C8 compensate for the gain roll-off of the succeeding amplifier stages. The hybrid network consisting of transformers T4, T5, T6, T7 splits the output of the preamplifier into four equal phase and amplitude signals at P1A, P2A, P3A, and P4A.

4.2.2 Driver Amplifier Module (A1) 350L-4181

The schematic of the driver amplifier module is shown in figure 7-1. Input signal fed to J1A is matched, split and inverted by transformers T1 and T2. Two equal amplitude, phase reversed, signals are fed to the inputs of transistors Q1 and Q2. The output of transistors Q1 and Q2 are coupled to the base of power output transistors Q3 and Q4 through matching transformers T3 and T4. Reversing hybrid transformer T5 combines the power output of Q3 and Q4 and couples even order harmonics to resistor R2. Transformer T6 matches the output impedance to 50 ohms.

4.2.3 Power Amplifier Module (A21) 350L-4184

The schematic of the power amplifier module is shown in figure 7-2. Input signal impressed at connector J5A is divided into two equal phase and amplitude signals by transformer T1. Each signal is fed to two identical power amplifier channels. The top channel signal is fed to a phase reversing hybrid consisting of transformers T2 and T3. Transistors Q1 and Q2 amplify the signal by 8 dB and feed their outputs to reversing hybrids T6 and T7. Transformer T10 sums the power outputs of the top and bottom channel

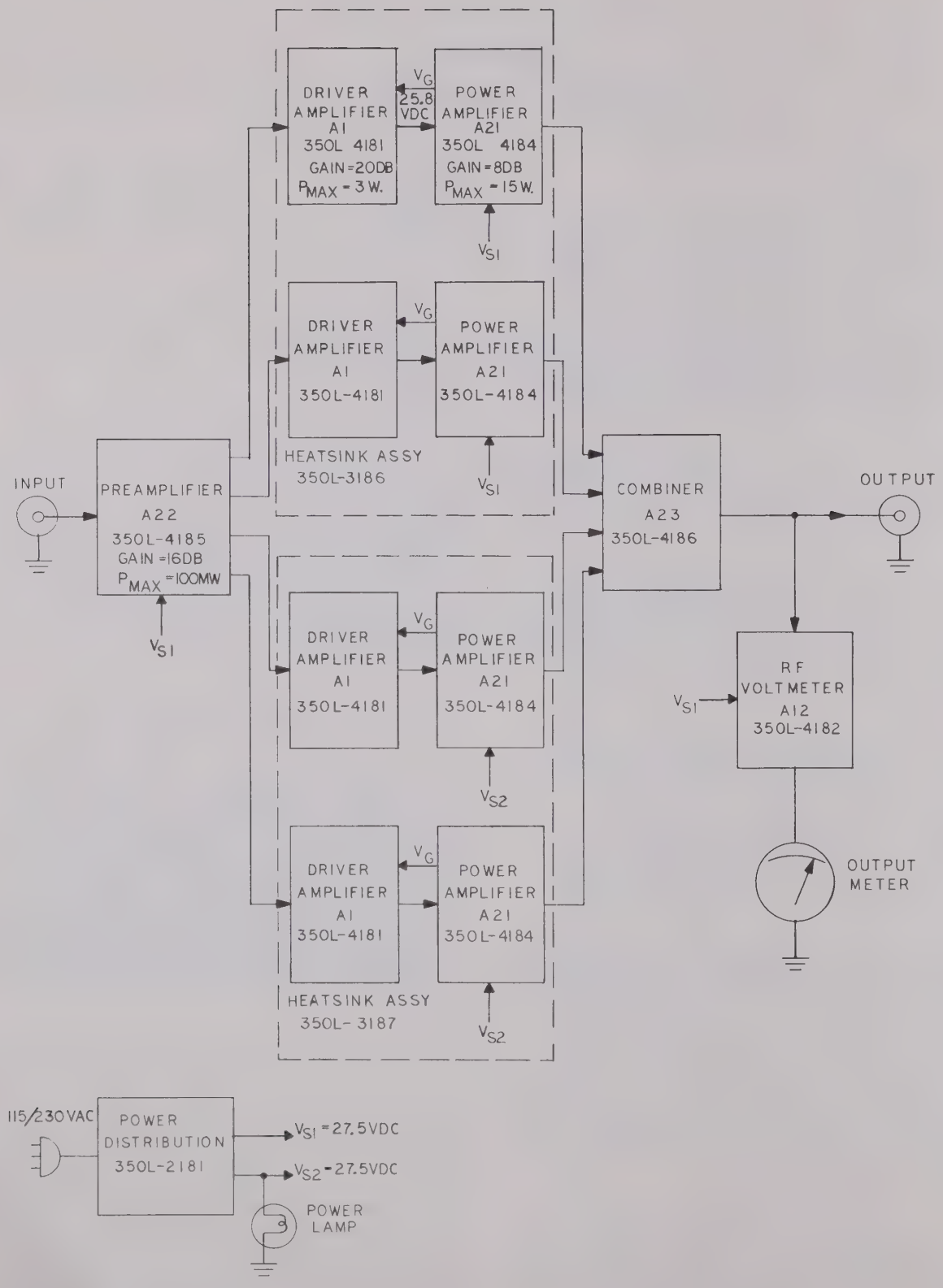


Figure 4-1. 350L Block Diagram

and transformer T11 matches the outputs to a 50 ohm load at connector J5B.

4.2.4 Combiner Module (A23) 350L-4186

The schematic of the combiner module is shown in figure 7-2. RF power impressed at connectors P5B, P6B, and P7B, P8B, is summed by hybrid transformers T1 and T2. Out of phase power is absorbed in resistors R1 and R2. Capacitors C1, C2, C3 and C4 compensate for the winding reactance in transformer T3 which sums the outputs of T1 and T2. Capacitors C5, C6 and transformer T4 match the summed RF output to the 50 ohm output at connector J12.

4.2.5 RF Voltmeter Module (A12) 350L-4182

The schematic of the RF voltmeter module (A12) is shown in figure 7-2. Resistors R1, R2, R3, R4, and R5 make up a high impedance voltage divider and are connected to the RF output voltage at the 350L output connector. A fast switching hot carrier diode CR1 rectifies the RF voltage from the divider. Capacitor C3 compensates for the high frequency roll-off of the diode CR1. Resistors R5, R6, R7 and capacitor C1 filter the rectified RF and convert it to DC which is fed to the front panel meter.

4.2.6 Power Distribution 350L-2181

A schematic of the power distribution is shown in figure 7-3. The 115/230 volts AC is distributed from terminal block TB1 to power transformer T1 and to the 115/230 volt switch. The secondary of T1 supplies voltage to two full wave bridge rectifiers CR1 and CR2. The output of each rectifier is connected to capacitors C1, C2 and the collectors of Q1, Q2, Q3, Q4 and Q5 located on the transistor assemblies (350L-4188). These transistors form a series pass regulator of the dissipative type. The output of each rectifier is also connected to separate integrated circuit voltage regulators IC-1 and IC-2 located on the power supply regulator board (A31) 350L-4187. The output voltage of each supply is adjusted by potentiometer A31R2 and A31R7.

CHAPTER 5
PERFORMANCE TEST PROCEDURES

5.1 PERFORMANCE TESTS

5.1.1 General

There are three tests required to check the operation and performance of the Model 350L. These tests are as follows: the gain and gain variation test, the RF output power test and the RF output distortion test.

5.1.2 Test Equipment Required

The following test equipment is required for accomplishing the Model 350L performance tests. Equivalent substitutes for recommended models may be used.

a. Oscilloscope - Telequipment Model S54A
- or Telequipment Model D67
- or Tektronix Model D10 with 5A23N and 5A24N plug in units.

b. RF Generator/Sweeper - HP-8601A

c. 50 ohm Detector - HP 8471A
- or Wavetek D151

d. Attenuator, 30 dB, 50 watts - Bird 8321

e. Attenuator, 30 dB - HP-8491A

f. Attenuator, 10 dB, 20 watts - Narda 766-10

g. Calorimetric Power Meter - HP 434A

h. Spectrum Analyzer - HP 140T Display Unit
- HP 8554L Spectrum Analyzer-RF section
- HP 8552A Spectrum Analyzer-IF section

5.1.3 Gain and Gain Variation Test

The purpose of this test is to verify the gain and gain flatness versus frequency of the Model 350L.

5.1.3.1 CALIBRATION OF SET UP

a. Set-up the test equipment as shown in figure 5.1.

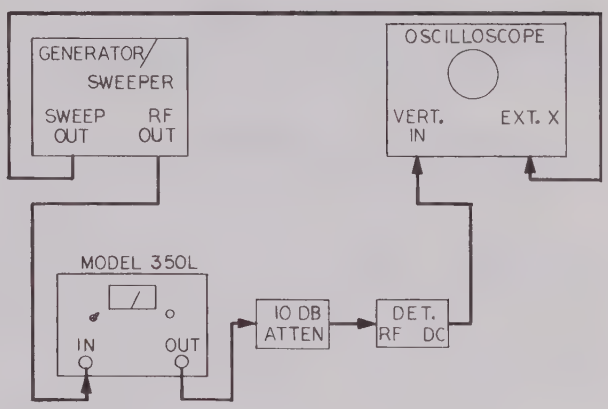


Figure 5-1. Gain and Gain Variation Test Set Up

b. Set oscilloscope to DC, Time/CM to Ext. X, and vertical gain to 10MV/CM.

c. Set the RF Generator/Sweeper to video sweep and frequency to 105 MHz.

d. Disconnect the Model 350L from the set-up and connect the Generator/Sweeper RF output directly to the 10dB attenuator.

e. Adjust the output level of the Generator/Sweeper for full vertical deflection on the oscilloscope face.

f. Calibrate the scope face to show 3 dB in 1 dB steps by attenuating the Generator/Sweeper in 1 dB steps and marking the traces with a grease pencil.

g. Return Generator/Sweeper output level to full deflection. Rotate the step attenuator on the Generator/Sweeper (CCW) so that the output is reduced by 50 dB.

h. Reconnect Model 350L into the test set up of figure 5-1.

5.1.3.2 MEASUREMENT PROCEDURE

a. Turn on the Model 350L power switch.

b. Observe the gain versus frequency sweep on the oscilloscope.

1. The average gain should be 50 dB (within 1 dB).

2. The gain variation should be within the 3 dB markings as shown on the scope face.

5.1.4 RF Output Power Test

The purpose of the RF output power test is to verify that the Model 350L will deliver more than 50 watts of RF power over the frequency range of 250 kHz to 105 MHz.

5.1.4.1 MEASUREMENT PROCEDURE

a. Set-up the test equipment as shown in figure 5-2.

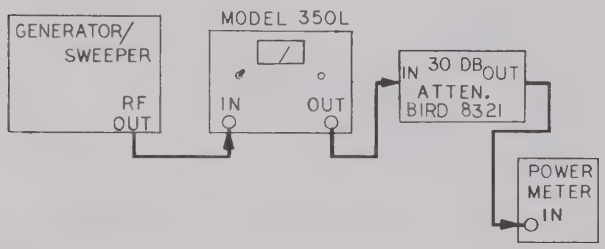


Figure 5-2. RF Output Power Test Set Up

b. Set the calorimetric power meter to .10 watt range. With the 30 dB series attenuator, this corresponds to a full scale deflection of 100 watts.

c. Set the Generator/Sweeper to CW, output level to 0 dBm and frequency to 250 kHz.

d. Slowly increase frequency while observing the power meter. Note that at every frequency up to 105 MHz, the power output is in excess of 50 watts.

5.1.5 RF Output Distortion Test

The purpose of this test is to verify that the harmonic distortion of the Model 350L and hence, its linearity is within specified limits.

5.1.5.1 MEASUREMENT PROCEDURE

a. Set-up the test equipment as shown in figure 5-3.

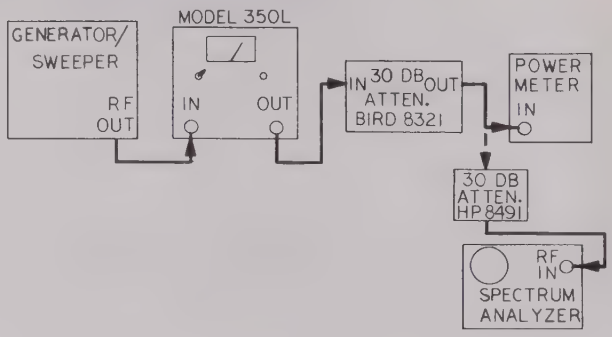


Figure 5-3. RF Output Distortion Test Set Up

b. Set the calorimetric power meter to .10 watt range. With the 30 dB series attenuator, this corresponds to a full scale deflection of 100 watts.

c. Set Generator/Sweeper to CW and frequency to 250 kHz.

d. Adjust the Generator/Sweeper output level so that the output power indicated on the calorimetric power meter is 50 watts.

e. Disconnect the cable from the power meter and connect it to the Spectrum Analyzer through a 30 dB attenuator.

f. Observe that the 3rd harmonic is at least 20 dB below the fundamental and the 2nd harmonic is at least 30 dB below fundamental signal.

g. Repeat steps d. through f with the generator frequency set at 1MHz, 10MHz, 40MHz, and 105 MHz in succession.

CHAPTER 6
TROUBLESHOOTING AND REPAIR

6.1 TROUBLESHOOTING

The first step in isolating a malfunction is to review the conditions under which the symptoms were observed and check that it was not caused by the external cabling or associated test equipment. Before proceeding to the detailed test procedures, a complete visual inspection of the 350L should be accomplished. Check for burnt or discolored components, loose cable connectors and broken wires and note any details which might localize the malfunction.

Commonly found symptoms together with their probable cause and troubleshooting recommendations are listed in the Troubleshooting Guide, Table 6-1.

Table 6-1. Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
Power lamp does not light	Burned out bulb	Check for 27.5 volts across bulb.
	Defective Power Supply	Perform test in section 6.3.1.1.
	Thermal Switch Open	If TS1 contacts do not close after unit has cooled, replace thermal switch.
	Defective Power Switch	Replace switch (S1).
	Blown Fuse	Replace fuse with 8 amp. 3AG S.B.
Power Lamp dim	Power supply out of adjustment	Perform Power Supply Adjustment Section 6.3.1.2.
	115/230 volt line switch in wrong position	Check for correct position of switch (S2).
Blown Fuse	Defective Power Supply	Perform test in section 6.3.1.1.
	Wrong Fuse	Check to see that 8 amp. 3AG S.B. is installed.
	Defective line cord or AC wiring	Visually inspect for signs of insulation breakdown.
No RF Output or Gain	Broken Input or Output BNC Connector	Visually inspect connectors for broken pins.
	Defective Input or Output internal cables	Visually inspect cables at input and output connectors.
	Defective Preamplifier Module	Replace Q1 in the preamplifier module (A22) 350L-4185

Table 6-1. Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
Low RF Output or Gain	Defective input cables	Visually inspect cables
	Faulty Power Supply Adjustment	Perform Power Supply Adjustment section 6.3.1.2.
	Defective RF Amplifier Module	Perform procedure for Faulty RF module, section 6.2.
Excessive Distortion	Defective Power Amplifier Module	Perform procedure for locating faulty RF module section 6.2.
Amplifier Overheating	Defective Fan	Check that fan is operating properly
	Ambient air is above specifications	Measure the ambient temperature.
	Defective Power Supply	Perform test in section 6.3.1.
Incorrect Front Panel Meter Indication	Improper Calibration or defective RF voltmeter board (A12)	Perform RF voltmeter adjustment section 6.2.3.
	Defective Meter	Replace meter
Meter reads up scale with input and output cables removed	Sticking meter movement	Replace meter
	Unit oscillating because of loose or defective internal coax cable connections	Tighten all RF connectors
Excessive ripple on gain versus frequency sweep of amplifier	Ripple on power supply	Perform DC power supply test section 6.3.1.1.

6.2 LOCATING FAULTY RF MODULE

6.2.1 General

The input and output impedance of each of the RF modules in the Model 350L is 50 ohms. Therefore, they can be disconnected from each other at any point and tested independently. The following section provides a method of locating a faulty RF module. Figure 6-1 through 6-4 shows the location of heatsink assemblies, modules and major components.

6.2.2 Isolating Amplifier Problem

a. Set-up the test equipment as shown in figure 5-2 for RF output power test.

b. Set the Generator/Sweeper to CW, frequency to 30 MHz and output level to 0 dBm. If the 350L output power is considerably less than 50 watts, as indicated on the power meter, a faulty RF module may exist.

c. Disconnect the coaxial cable from J5B of the power amplifier module (A21) and observe the output power of the 350L, as indicated on the calorimetric power meter. The power will drop by 44% (±6%) for a properly functioning power amplifier and driver combination. Reconnect the coaxial cable to J5B and remove the coaxial cable from J6B. Observe power drop. Repeat identical procedure for J7B and J8B. If the output power drops an equal amount (within 5%) as each cable is removed, the fault is in either the

combiner module (A23) or the preamplifier module (A22). Perform tests in section 6.2.2.1 and 6.2.2.2.

If the output power does not drop or drops less than normal, as each of the cables is removed, the fault is in either the driver amplifier module (A1) or the power amplifier module (A21) associated with that cable.

6.2.2.1 COMBINER MODULE (A23) TEST

a. Set the Generator/Sweeper to CW, frequency to 30 MHz, output level to 0 dBm and connect it to the 350L input. Connect a 50 ohm, 50 watt load (Bird 8130) to the output of the 350L. Connect the calorimetric power meter in series with a 10 dB, 20 watt attenuator (Narda 766-10). Set the meter range to 10 watts which corresponds to a full scale deflection of 100 watts. Connect each power amplifier module (A21) output (J5B, J6B, J7B, and J8B) to the attenuator in succession and record their individual output powers.

b. Using the set-up of figure 5-2, measure and record the total output power.

c. The sum of the powers from step a. should be within 15 percent of the total output power recorded in step b. If they are not, the combiner module (A23) is faulty.

6.2.2.2 PREAMPLIFIER MODULE (A22) TEST

If the test in section 6.2.2 shows that the outputs at J5B, J6B, J7B and J8B of the power amplifier modules (A21) are equal and the combiner module (A23) is not faulty, then the preamplifier module (A22) is suspect. A check of the power supply per section 6.3.1.1 should be performed to conclude positively that the preamplifier module is faulty.

6.2.2.3 HEATSINK ASSEMBLY TEST (350L-3186-3187)

Two tests are required to test a heatsink assembly. They are a bias voltage check and an RF power test. In order to perform these tests the following test equipment is required. Equivalent substitutes may be used for the recommended models.

1. DVM - Fluke 8000A
   - or Fluke 8100A
   - or Weston 1241
2. Generator/Sweeper - HP8601A
3. Calorimetric Power Meter - HP434A
4. Attenuator, 30 dB, 50 watts - Bird 8321
5. Power Supply, Lamda LK-343-AFM
6. Cooling Fan - Rotron Type 113

6.2.2.3.1 Bias Voltage Check

a. Adjust the power supply to 27.5 volts.

b. Connect the power supply minus (—) lead to the heatsink. Connect the power supply positive (+) lead to either inner terminal of TB1 on the heatsink assembly.

c. Position the cooling fan so that the cooling air is directed at the heatsink assembly.

d. Verify the following transistor bias voltages:

   Driver Amplifier Modules (A1)

   (i) Emitters A1Q1 and A1Q2 - 1.2 to 1.4 volts DC.

   (ii) Emitters of A1Q3 and A1Q4 - 3.6 to 3.9 volts DC.

   Power Amplifier Modules (A21)

   (i) Emitters of A21Q1 through A21Q4 - 3.6 to 3.9 volts DC.

e. If all voltages are within tolerance procede to the RF Power Test.

6.2.2.3.2 RF Power Test

a. Set up the test equipment as shown in figure 5-2 with heatsink assembly substituted for the 350L.

b. Set the Generator/Sweeper to CW, frequency to 105 MHz and output level to +20 dBm.

c. The calorimetric power meter will indicate more than 15 watts for a properly functioning driver and power amplifier combination.

d. If 15 watts is not obtained, remove the power meter from the output of the power amplifier module (A21) and connect it directly to the output of its associated driver amplifier module (A1). The driver amplifier module (A1) should indicate more than

2.5 watts of output power. If the driver amplifier module is operating properly, the power amplifier module is faulty.

6.2.3 RF Voltmeter (A12)

The Model 350L output meter should be accurate to within ± 4 watts of the actual output power. If the meter is out of calibration, the following alignment procedure must be used:

6.2.3.1 ALIGNMENT PROCEDURE

a. Set up the test equipment as shown in figure 5-2.

b. Set the Generator/Sweeper for CW, and frequency to 1 MHz. Adjust the output level so that 50 watts is indicated on the calorimetric power meter.

c. Adjust the potentimeter A12R7, located on the RF voltmeter module so that the front panel meter indicates 50 watts.

d. Set the Generator/Sweeper to 105 MHz and adjust the output level so that 50 watts is indicated on the calorimetric power meter. Adjust the wire gimmick (Capacitor C3) around the diode A12CR1 until the front panel meter indicates 50 watts.

6.3 DC POWER SUPPLY

6.3.1 General

The following test and adjustment procedure should be performed after the replacement of a power supply sub-assembly (transistor assembly 350L-4188 or regulator board 350L-4187), or if the power supply voltages are out of adjustment.

The power supply regulator board (A31) is divided into two separate voltage regulators. The left side supplies DC voltage to the left heatsink assembly (350L-3186) and is adjusted by A31R2. The right side supplies DC voltage to the right heatsink assembly (350L-3187) and the preamplifier module (A22) 350L-4185 and is adjusted by A31R7.

6.3.1.1 TEST PROCEDURE

a. To test DC power supply, the following test equipment is required.

1. Digital Voltmeter - Fluke 8000A
   - or Fluke 8100A
   - or Weston 1241
   or equivalent

2. Oscilloscope - Telequipment S54D
   or - Tektronix 545
   or equivalent

b. Disconnect all external cables from the Model 350L.

c. Connect the DVM minus (—) lead to the chassis and the positive (+) lead to the far left terminal of TB1 on the power supply regulator board (A31). The DVM should indicate 27.5 volts DC.

d. Remove the positive (+) lead from the left terminal and connect it to the far right terminal of TB1. The DVM should indicate 27.5 volts DC.

e. Connect the oscilloscope to the far left terminal on TB1. The 120 Hz ripple should be less than 50 millivolts. Repeat the above procedure with the oscilloscope connected to the far right terminal on TB1.

f. If the voltages measured in steps c and d are not between 27.5 and 27.8 volts then readjust the supply as indicated in section 6.3.1.2.

6.3.1.2 ADJUSTMENT PROCEDURE

a. Connect the DVM minus (—) lead to the chassis and the positive (+) lead to the far left terminal of TB1 on the power supply regulator board (A31).

b. Adjust potentiometer A31R2 so that the DVM indicates 27.5 - 27.8 volts.

c. Remove the positive (+) lead from the left terminals and connect it to the far right terminal of TB1.

d. Adjust potentiometer A31R7 until the DVM indicates 27.5 - 27.8 volts.

6.4 DISASSEMBLY PROCEDURES

6.4.1 General

The following disassembly procedures describe the recommended method of removing assemblies and modules for the purpose of test, repair, or replacement. Careful handling should be used to avoid damaging circuit boards.

6.4.2 Tools Required

The Model 350L amplifier is assembled with standard hardware. Screw sizes range from #2-56 to #8-32, and are of the

Phillips or slotted types. Standard tools are required for their removal.

6.4.3 Removal of Cover

Remove all screws (6-#8-32 and 2-#6-32) located on both sides of the cover and carefully lift the cover up.

To replace the cover, simply reverse the process. When replacing the cover, care should be taken that the case does not come in contact with the internal amplifier cabling.

6.4.4 Preamplifier Module (A22) 350L-4185

a. Remove the six #4-40 screws holding the module to the heatsink assemblies (350L-3186 and 3187).

b. Untie the two cable harnesses and remove the four output cables from the inputs of the driver amplifier modules (P1A, P2A, P3A and P4A).

c. Unsolder the coaxial cable from the input connector on combiner module (A23,J11).

d. Disconnect the power supply wire from TB1 on power supply regulator board (A31).

6.4.5 Combiner Module (A23) 350L-4186

a. Remove the four #4-40 screws holding the module to the heatsink assemblies (350L-3186 and 3187).

b. Untie the cable harness and remove the four input cable connectors from the outputs of the power amplifier modules (P5B, P6B, P7B and P8B).

c. Unsolder the coaxial cable connected to the input connector (J11).

d. Disconnect the front panel coaxial cables from the input and output BNC connectors (J11 and J12).

6.4.6 Power Supply Regulator Board (A31) 350L-4187

a. Remove the four #4-40 screws holding the board to the heatsink assemblies (350L-3186 and 3187).

b. Unsolder the six wires (two red, two white and two blue) from the underside of the board.

c. Remove the power supply wires from terminal block TB1.

6.4.7 Heatsink Assemblies (350L-3186 and 3187)

a. To remove either heatsink assembly it is necessary to remove the preamplifier module, the combiner and the power supply regulator (see section 6.4.4 through 6.4.6).

b. Remove the five #6-32 hold down screws from the base plate for each heatsink assembly.

6.4.8 Transistor Assemblies (350L-4188)

a. Remove the ten #6-32 screws holding both heatsink assemblies to the base plate.

b. Remove the four #4-40 screws holding the power supply regulator board (A31) to the heatsink assemblies.

c. Lift the complete 350L RF assembly carefully from the base plate.

d. Remove the two #6-32 screws holding each transistor assembly to the base plate.

e. Unsolder the four wires (red, white, blue and blue) connected to each transistor assembly.

6.4.9 Driver Amplifier Module (A1) 350L-4181

a. Remove the heatsink assembly (see section 6.4.7).

b. Remove the coaxial cable from the output connector on the driver amplifier (P1B, P2B, P3B or P4B).

c. Remove the two #4-40 screws holding the driver amplifier module to the heatsink.

d. Remove the two #10 nuts holding the stud mounted transistors to the heatsink.

e. Remove the power supply wire from the terminal block.

f. Lift the module from the heatsink, carefully removing the two transistors from the heatsink cups.

Note

When replacing stud mounted transistors, do not use excessive torque (4 inch pounds maximum).

6.4.10 Power Amplifier Module A21 (350L-4148)

a. Remove the heatsink assembly (see section 6.4.7).

b. Remove the coaxial cable from the input connector of the power amplifier module (P5A,P6B,P7B, or P8B).

c. Remove the four #4-40 screws holding the power amplifier module to the heatsink.

d. Remove the two red wires connected to the terminal block.

CAUTION

The red wires connected to the inside terminals of the terminal block (TB1) are the +27.5 VDC line for the power amplifier module. The red wires connected to the outside terminals are the +25.8 VDC for the driver amplifier module. If these wires are reversed, the power amplifier module can be damaged.

e. Carefully lift the power amplifier module off the four transistors Q1, Q2, Q3 and Q4.

Note

When replacing power amplifier module (A21) make sure all four transistors are lined up with sockets before securing board to heatsink.

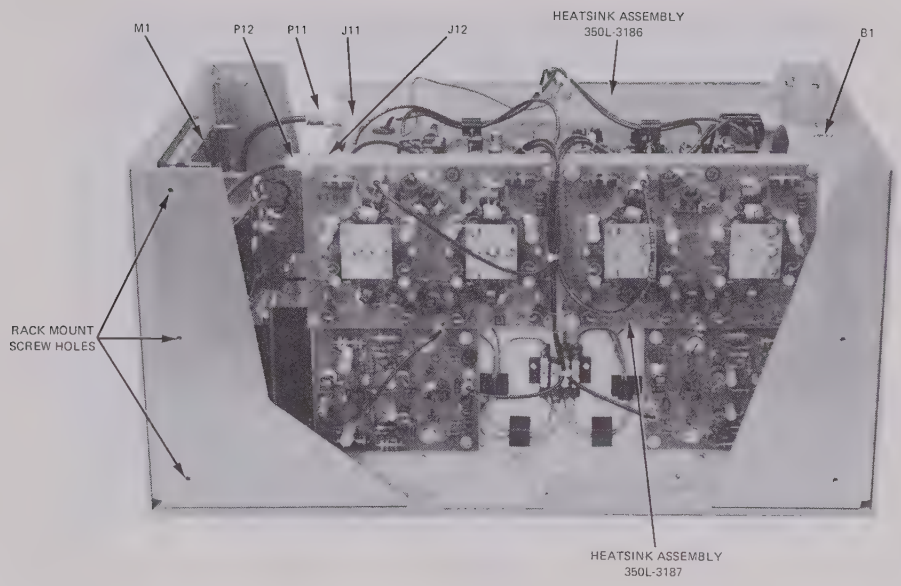


Figure 6-1. Side View, Component Location

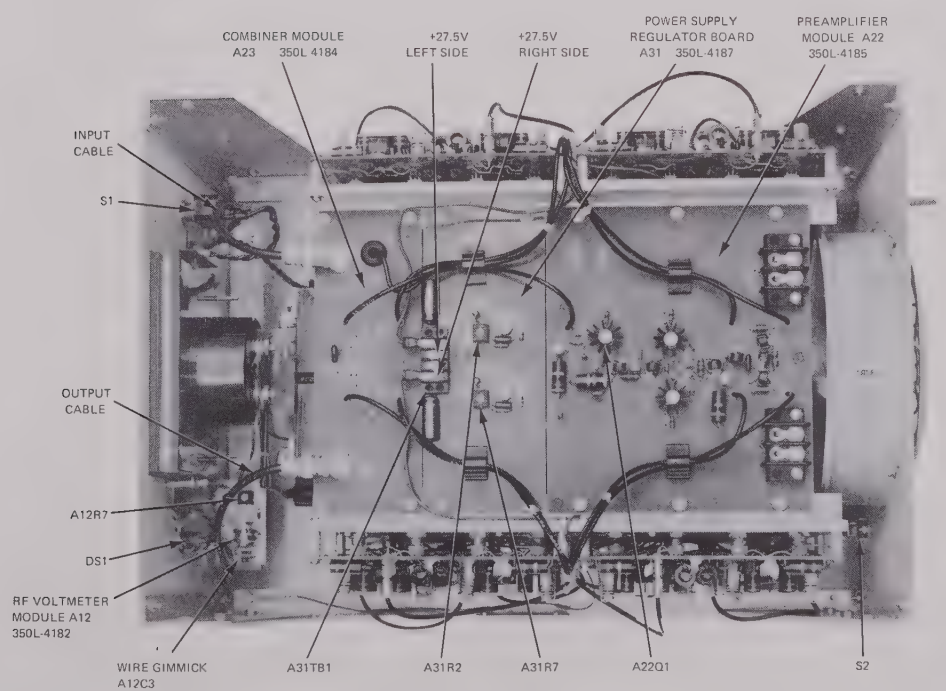


Figure 6-2. Top View Module and Component Location

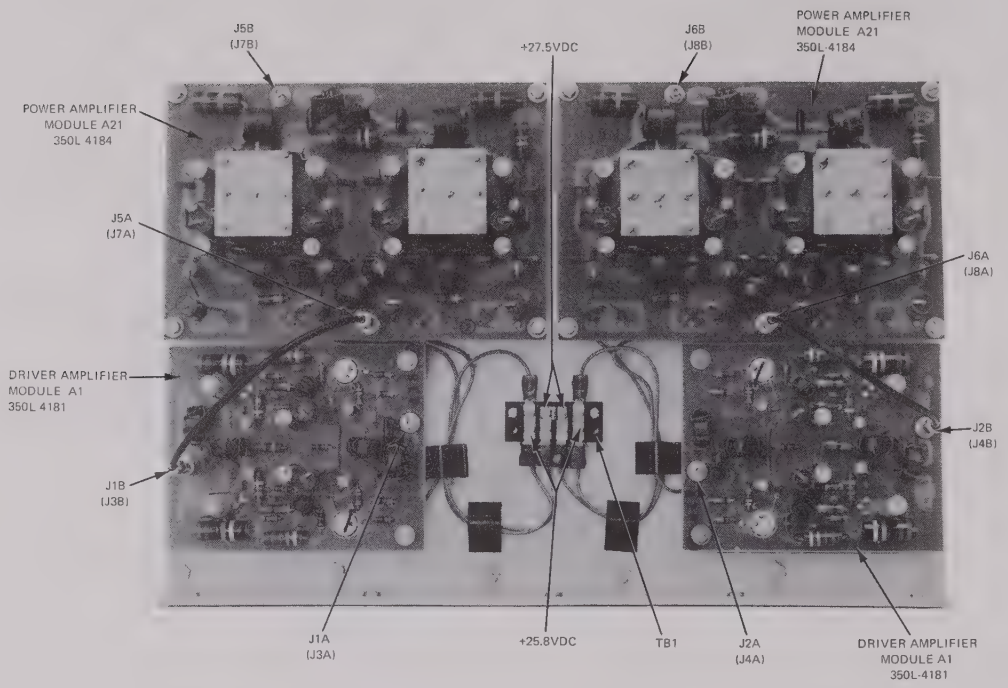


Figure 6-3. Heatsink Assembly (350L-3186 and 3187)

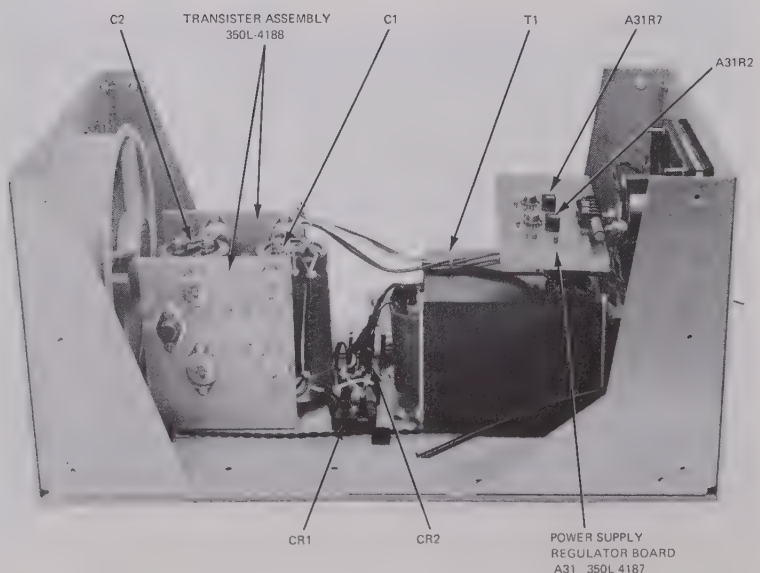


Figure 6-4. Power Distribution (350L-2181)

CHAPTER 7
SCHEMATICS AND PARTS LIST

7.1 SCHEMATIC DIAGRAMS

Complete schematic diagrams appear in figures 7-1 through 7-3.

7.2 PARTS LIST

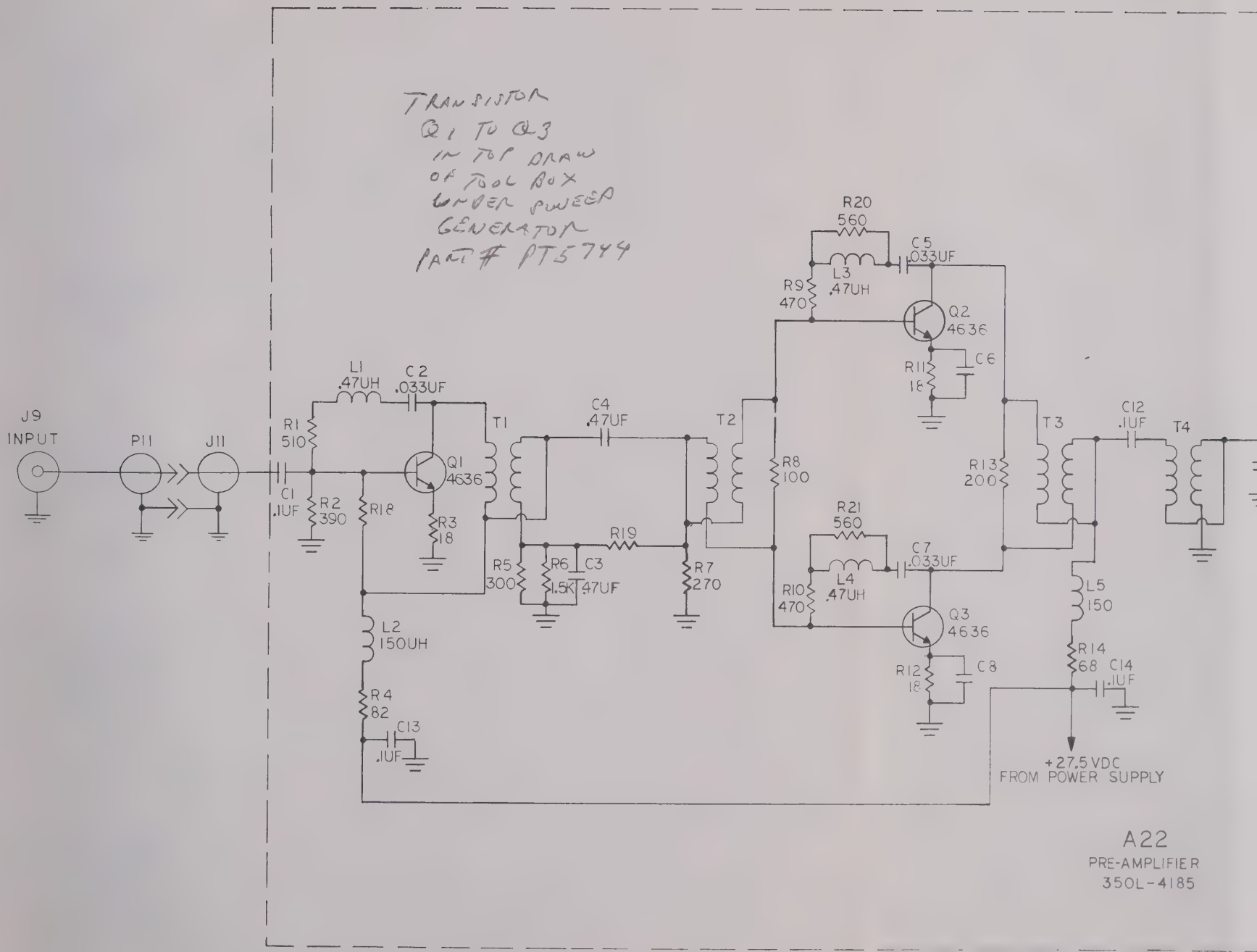
Table 7-1 provides a listing of all electrical parts and those mechanical parts which may be required for replacement. Electrical parts are listed by module number and by reference designations as indicated on the schematic diagrams. Parts list includes a description, part number and manufacturers federal supply code number. Table 7-2 provides a reference glossary of abbreviations used in the parts list.

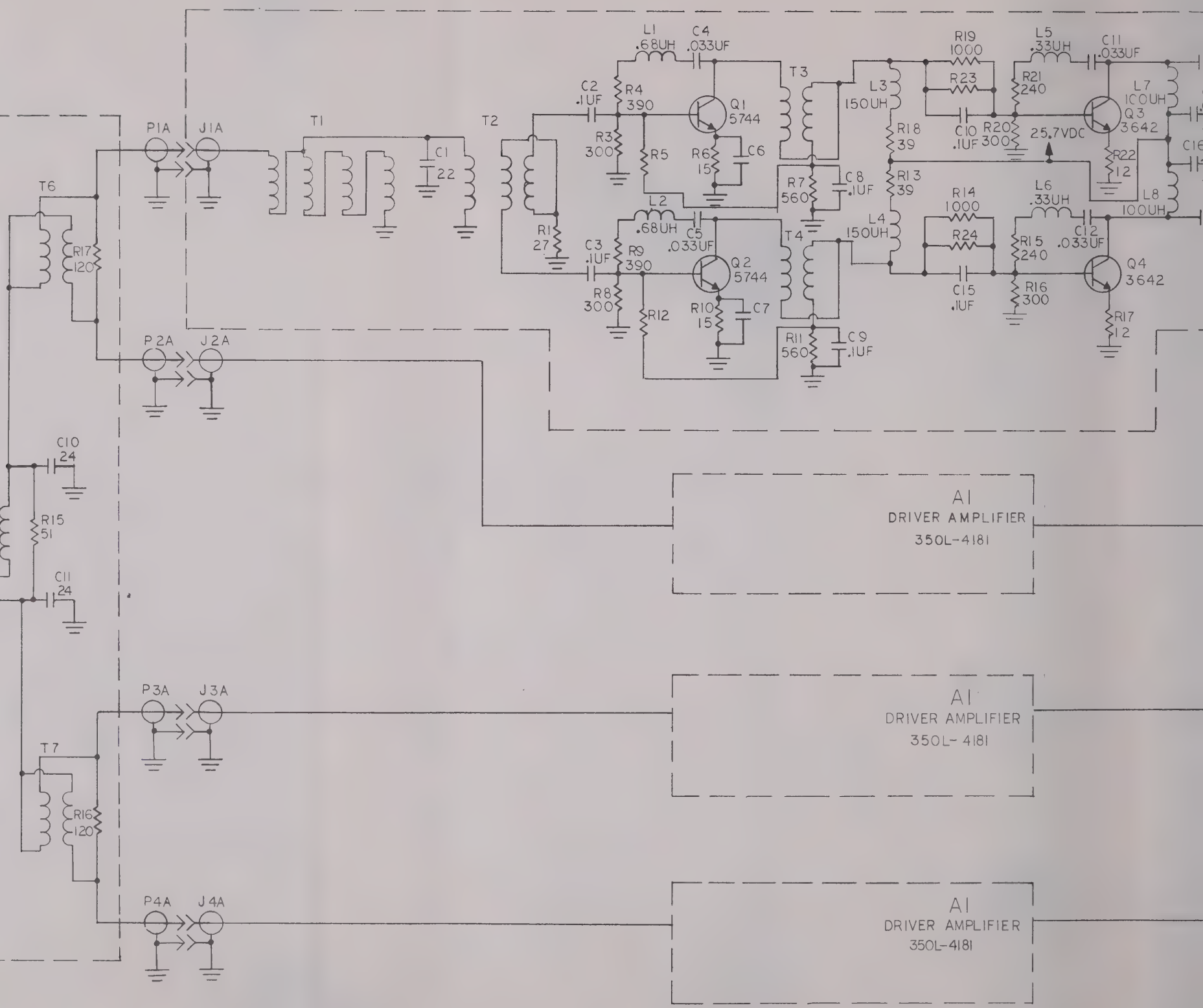
7.3 LIST OF MANUFACTURERS

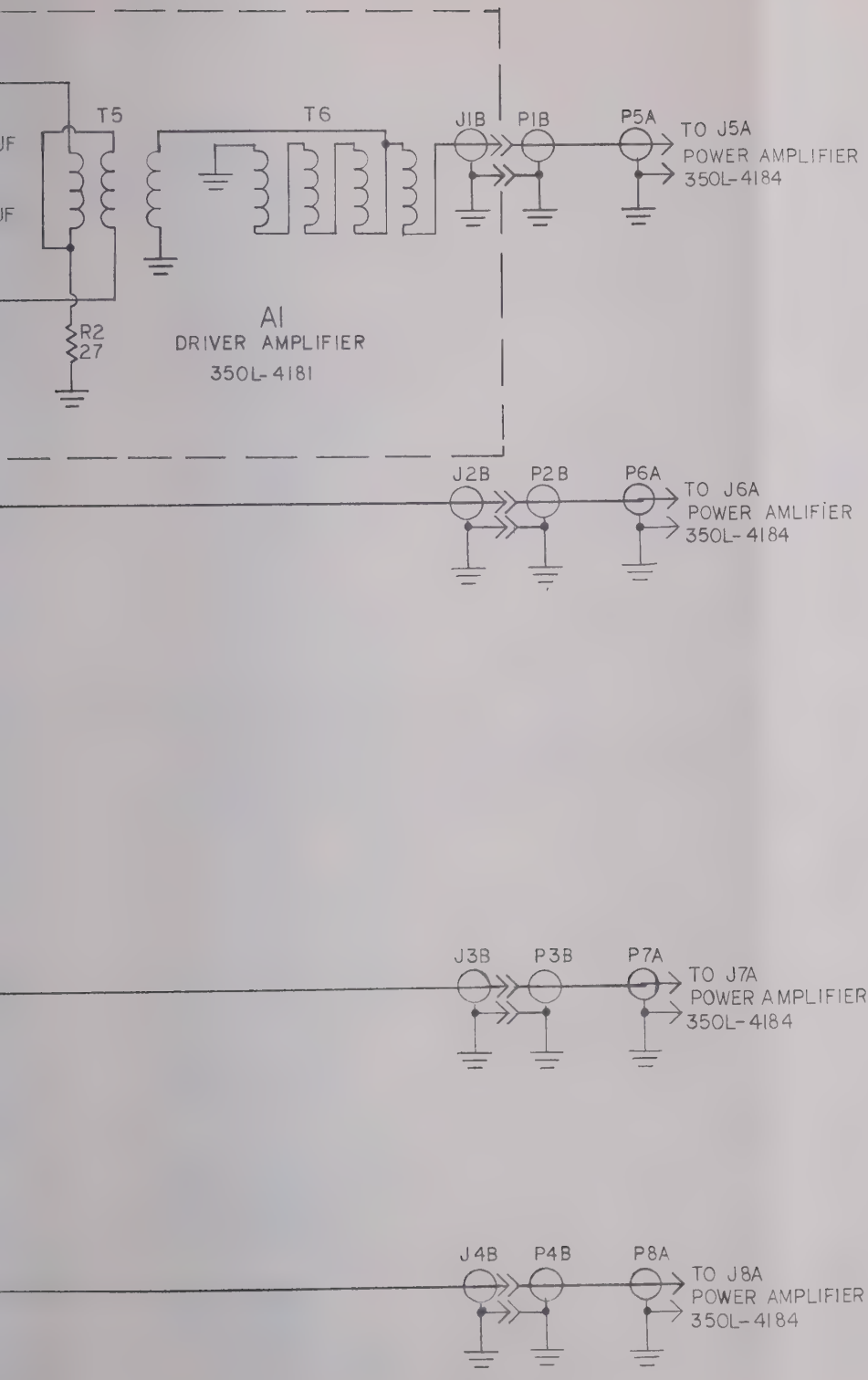
Table 7-3 provides a correlation of the manufacturers federal supply code numbers used in the parts list with the names and addresses of the manufacturers. If ENI's manufacturer code number (10226) appears, that part must be obtained directly from Electronic Navigation Industries, Inc.

7.4 Ordering Replacement Parts

To obtain replacement parts, address order or inquiry to Electronic Navigation Industries, Inc. or its authorized service facility. Identify parts by number as listed in the parts list.


TRANSISTOR
Q1 TO Q3
IN TOP DRAW
OF TOOL BOX
UNDER POWER
GENERATOR
PART # PT5744
J9
INPUT
P11
J11
C1
.1UF
R1
510
L1
.47UH
C2
.033UF
R2
390
R18
Q1
4636
R3
18
T1
C4
.47UF
R5
300
R6
1.5K
C3
.47UF
R19
R7
270
T2
R8
100
R20
560
L3
.47UH
R9
470
Q2
4636
C5
.033UF
R11
18
C6
R21
560
L4
.47UH
R10
470
Q3
4636
C7
.033UF
R12
18
C8
T3
R13
200
C12
.1UF
T4
L5
150
R14
68
C14
.1UF
L2
150UH
R4
82
C13
.1UF
+27.5 VDC
FROM POWER SUPPLY
A22
PRE-AMPLIFIER
350L-4185


P1A
J1A
T1
T2
C1
22
T6
R17
120
L1
.68UH
C4
.033UF
C2
.1UF
R4
390
Q1
5744
T3
R3
300
R5
R6
15
C6
R1
27
L2
.68UH
C5
.033UF
C3
.1UF
R9
390
Q2
5744
T4
R8
300
R12
R10
15
C7
R7
560
C8
.1UF
R11
560
C9
.1UF
L3
150UH
L4
150UH
R18
39
R13
39
R19
1000
R23
C10
.1UF
R14
1000
R24
C15
.1UF
L5
.33UH
R21
240
R20
300
25.7VDC
L6
.33UH
R15
240
R16
300
C11
.033UF
L7
100UH
Q3
3642
R22
12
C12
.033UF
Q4
3642
R17
12
L8
100UH
C16
P2A
J2A
C10
24
R15
51
C11
24
A1
DRIVER AMPLIFIER
350L-4181
P3A
J3A
T7
R16
120
A1
DRIVER AMPLIFIER
350L-4181
P4A
J4A
A1
DRIVER AMPLIFIER
350L-4181



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS.
2. DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE MARKED.
3. UNLESS OTHERWICE SPECIFIED ALL CAPACITORS ARE IN UUF.

Figure 7-1. Preamplifier and Driver Amplifier Section Schematic Diagram

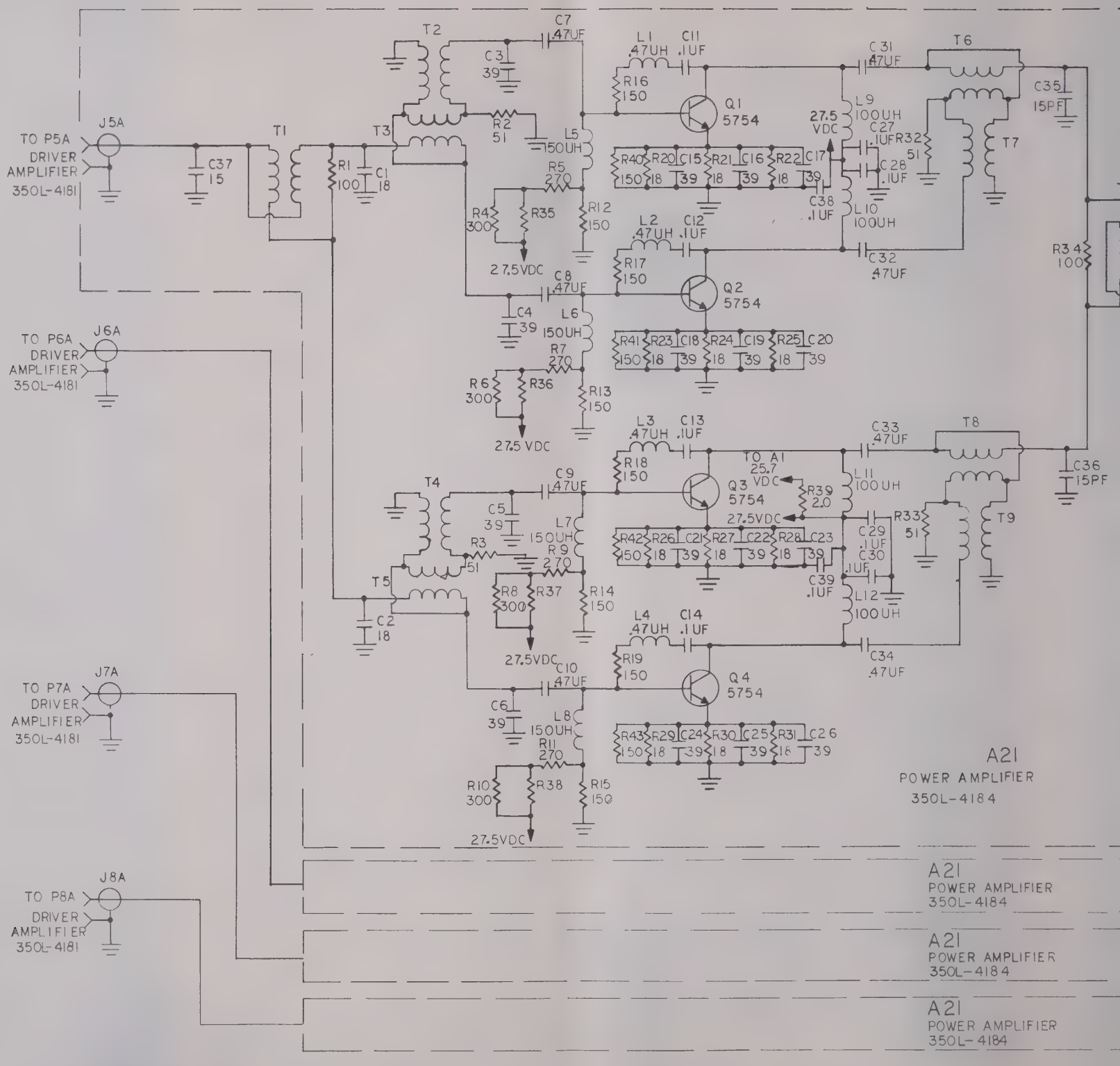
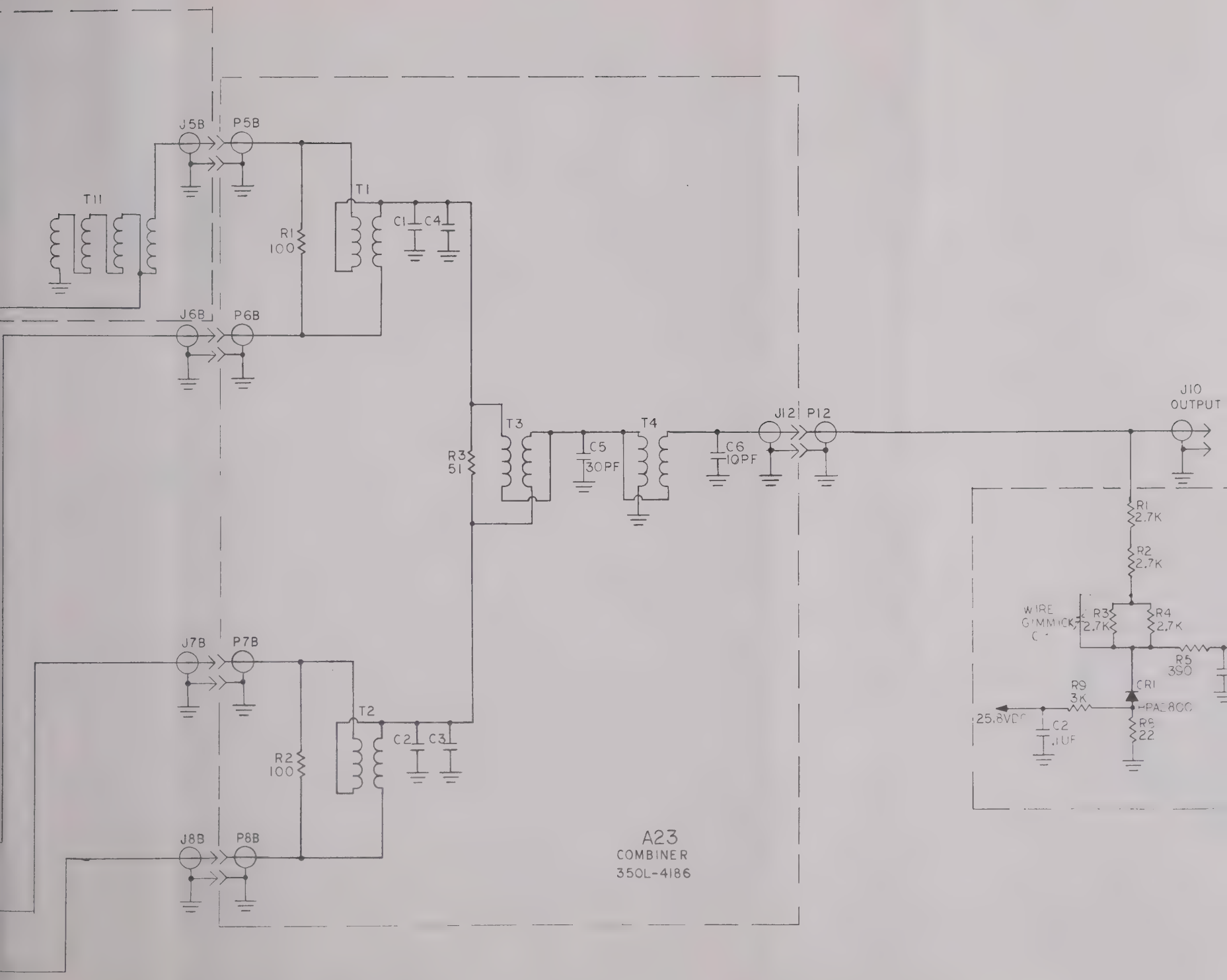
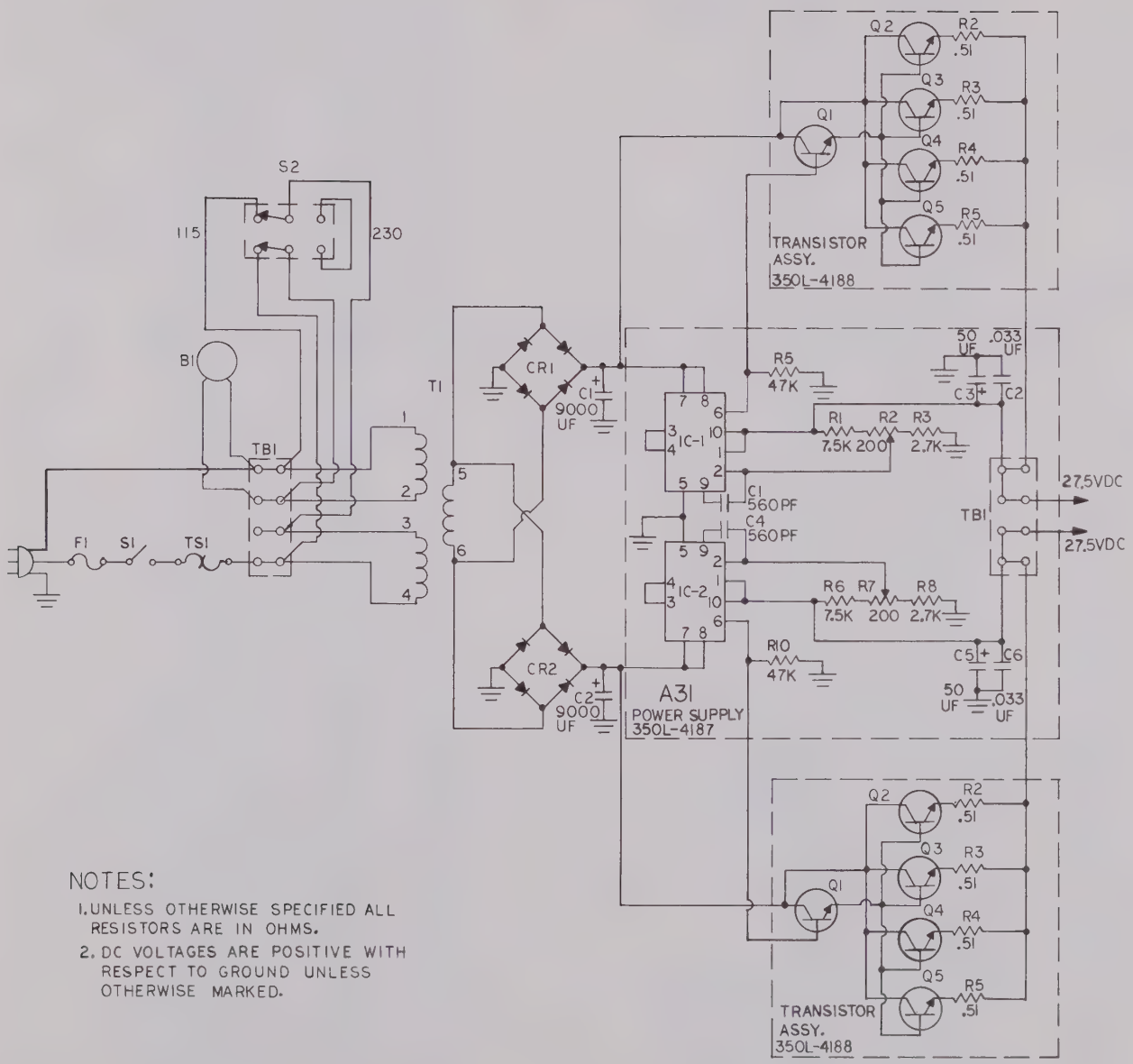


Figure 7-2. Power Amplifier, Combiner and RF Voltmeter Section, Schematic Diagram


J5B
P5B
T11
T1
R1
100
C1
C4
J6B
P6B
T3
T4
J12
P12
J10
OUTPUT
R3
51
C5
30PF
C6
10PF
R1
2.7K
R2
2.7K
WIRE
GIMMICK
C
R3
2.7K
R4
2.7K
R5
390
R9
3K
CR1
HPA2800
25.8VDC
C2
.1UF
R8
22
J7B
P7B
T2
R2
100
C2
C3
J8B
P8B
A23
COMBINER
350L-4186

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS.
2. DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE MARKED.
3. UNLESS OTHERWISE SPECIFIED ALL CAPACITORS ARE IN UUF.



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS.
2. DC VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE MARKED.

Figure 7-3. Power Supply Section, Schematic Diagram

Table 7-1. Replacement Parts List.

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
	CHASSIS MOUNTED PARTS (NO PREFIX):		
B1	Motor, Fan	82877	Type 113
C1,C2	Capacitor Elect, 9000UF 50 VDCW	56289	36D902G050BC2A
CR1,CR2	25A FW BRIDGE	04713	MDA990-2
DS1	LAMP 28VDC-40MA	72619	101-8430-0931-201
F1	FUSE TYPE 3AG 8ASB	75915	313008
XF1	FUSE HOLDER	75915	342001
J9,J10	JACK, TYPE BNC	13511	UG-624B/U
M1	METER	32171	840-494A
S1	SWITCH, 3/4 HP	31356	ST 42A(MS35058-9)
S2	SWITCH, SLIDE DPDT	22753	622-HK-115/230
T1	TRANSFORMER, POWER	12715	AM 5862C
TB1	TERMINAL BLOCK	71785	4-172
TS1	THERMOSTAT	14604	2405-88-105
	TRANSISTOR ASSY. PARTS (NO PREFIX): 2 REQ.	10226	350L-4188
R2-R5	RES. W.W. .50ohms, 5%, 2 W	75042	BWH .5
Q1	TRANSISTOR	79089	40312
Q2-Q5	TRANSISTOR	04713	2N3715
A31	POWER SUPPLY REGULATOR BOARD (A31)	10226	350L-4187
A31R1	RES. FILM 7.5K 5% 1/2 W	16299	HC5-7.5K
A31R2	POT, VERTICAL MTG 200 ohms	32997	3389T-1-201
A31R3	RES, FILM 2.7K, 5%, 1/2 W	16299	HC5-2.7K
A31R4	POT, VERTICAL MTG, 200 ohms	32997	3389T-1-201
A31R5	RES, COMP 47K, 5% 1/4 W	01121	RC07GF473J
A31R6	RES FILM 7.5K, 5% 1/2	16299	HC5-7.5K
A31R7	POT VERTICAL MTG., 200 ohm	32997	3389T-1-201
A31R8	RES FILM 2.7K, 5% 1/2 W	16299	HC5-2.7K
A31R9	POT VERTICAL MTG, 200 ohm	32997	3389T-1-201
A31R10	RES COMP, 47K 5% 1/4	01121	RC07GF473J
A31C1	CAP, MICA 560Pf, 5%	09023	CM06ED561J03
A31C2	CAP, 50V, 20%, .033 UF	72982	8121-050-651-333M
A31C3	CAP. ELECT 50 UF, 50 VDCW	56289	500D 506G050DD7
A31C4	CAP, MICA, 560Pf 5%	09023	CM06ED561J03
A31C5	CAP, ELECT., 50UF, 50 VDCW	56289	500D 506G050DD7
A31C6	CAP. 50V, 20%, .033UF	72982	8121-050-651-333M
A31IC-1	IC REGULATOR	49956	RC723CT
A31IC-2	IC REGULATOR	49956	RC723CT
A31TB-1	TERMINAL BLOCK	71785	4-172
A22	PREAMPLIFIER MODULE (A22)	10226	350L-4185
A22R1	RES. COMP, 510 ohm 5%, 1/2 W	01121	RC20GF511J
A22R2	RES. COMP, 390 ohm 5%, 1/4 W	01121	RC07GF391J
A22R3	RES, COMP, 18 ohm, 5%, 1/4 W	01121	RC07GF180J
A22R4	RES, COMP, 82 ohm, 5%, 2 W	01121	RC42GF820J
A22R5	RES, COMP, 300 ohm, 5% 2 W	01121	RC42GF301J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A22R6	RES, COMP, 1.5K, 5% 1/2 W	01121	RC20GF152J
A22R7	RES. COMP, 270 ohm 5% 1/4 W	01121	RC07GF271J
A22R8	RES. COMP, 100 ohm 5% 1/4 W	01121	RC07GF101J
A22R9-R10	RES. COMP, 470 ohm 5% 1/4 W	01121	RC076F471J
A22R11-R12	RES. COMP, 18 ohm 5% 1/4 W	01121	RC07GF180J
A22R13	RES. COMP, 200 ohm 5% 1/2 W	01121	RC20GF201J
A22R14	RES. COMP, 68 ohm 5% 2 W	01121	RC42GF680J
A22R15	RES. COMP, 51 ohm 5% 1/2 W	01121	RC20GF510J
A22R16-R17	RES. COMP, 120 ohm 5% 1/2 W	01121	RC20GF121J
A22R18	RES. COMP, 3.6 K 5% 1/4 W	01121	RC07GF362J
A22R19	RES. COMP, 2 K 5% 1/2 W	01121	RC20GF202J
A22R20-R21	RES. COMP, 560 ohm 5% 1/4 W	01121	RC07GF561J
A22C1	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A22C2	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A22C3	CAP, CER, 0.47UF, 50 VDCW	72982	8131-050-651-474Z
A22C5	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A22C6	CAP, MICA, 56Pf, 5%	09023	CM05ED560J03
A22C7	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A22C8	CAP, MICA, 56Pf, 5%	09023	CM05ED560J03
A22C9	CAP, MICA, 27Pf, 5%	09023	CM05ED270J03
A22C10-C11	CAP, MICA, 24Pf, 5%	09023	CM05ED240J03
A22C12-C15	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A22L1	CHOKE, RF, 0.47UH, 10%	99800	MS18130-4
A22L2	CHOKE, RF, 150UH, 10%	99800	MS75052-7
A22L3-L4	CHOKE, RF, 0.47UH, 10%	99800	MS18130-4
A22L5	CHOKE, RF, 150UH, 10%	99800	MS75052-7
A22T1-T7	TRANSFORMER	10226	
A22Q1-Q3	TRANSISTOR SIL, NPN	10226	4636
A1	DRIVER AMPLIFIER MODULE (A1) (4 PER UNIT)	10226	350L-4181
A1R1	RES. COMP, 27 ohm, 5%, 1/4 W	01121	RC07GF270J
A1R2	RES, COMP, 27 ohm, 5%, 1/2 W	01121	RC20GF270J
A1R3	RES, COMP, 300 ohm, 5%, 1/4 W	01121	RC07GF301J
A1R4	RES, COMP, 390 ohm, 5% 1/4 W	01121	RC07GF391J
A1R5	RES, COMP, SELECTED	01121	RC07
A1R6	RES, COMP, 15 ohm, 5% 1/4 W	01121	RC07GF150J
A1R7	RES, COMP, 560 ohm, 5%, 1 W	01121	RC32GF561J
A1R8	RES, COMP, 300 ohm, 5% 1/4 W	01121	RC07GF301J
A1R9	RES, COMP, 390 ohm 5%, 1/4 W	01121	RC07GF391J
A1R10	RES, COMP, 15 ohm, 5%, 1/4 W	01121	RC07GF150J
A1R11	RES, COMP, 560 ohm, 5%, 1 W	01121	RC32GF561J
A1R12	RES, COMP, SELECTED	01121	RC07
A1R13	RES, COMP, 39 ohm 5% 2 W	01121	RC42GF390J
A1R14	RES, COMP, 1 K ohm, 5%, 1/2 W	01121	RC20GF102J
A1R15	RES, COMP, 240 ohm, 5%, 1/2 W	01121	RC20GF241J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A1R16	RES, COMP, 300 ohm, 5%, 1/4 W	01121	RC07GF301J
A1R17	RES, COMP, 12 ohm, 5%, 2 W	01121	RC42GF120J
A1R18	RES, COMP, 39 ohm, 5%, 2 W	01121	RC42GF390J
A1R19	RES, COMP, 1 K ohm, 5%, 1/2W	01121	RC20GF102J
A1R20	RES, COMP, 300 ohm, 5% 1/4 W	01121	RC07GF301J
A1R21	RES, COMP, 240 ohm, 5% 1/2 W	01121	RC20GF241J
A1R22	RES, COMP, 12 ohm, 5% 2 W	01121	RC42GF120J
A1R23-R24	RES, COMP, SELECTED	01121	RC07
A1C1	CAP, MICA, 22RF, 5%	09023	CM05ED220J03
A1C2-C3	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A1C4-C5	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A1C6-C7	NOT ASSIGNED		
A1C8-C10	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A1C11-C12	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A1C13-C15	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A1C16-C17	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A1L1-L2	CHOKE, RF, 0.68UH, 10%	99800	MS18130-6
A1L3-L4	CHOKE, RF, 150UH, 10%	99800	MS75052-7
A1L5-L6	CHOKE, RF, 0.33UH, 10%	99800	MS18130-3
A1L7-L8	CHOKE, RF, 100UH, 10%	99800	MS91189-37
A1T1	TRANSFORMER	10226	
A1T2	TRANSFORMER	10226	
A1T3	TRANSFORMER	10226	
A1T4	TRANSFORMER	10226	
A1T5	TRANSFORMER	10226	
A1T6	TRANSFORMER	10226	
A1Q1-Q2	TRANSISTOR, SIL, NON	10226	5754
A1Q3-Q4	TRANSISTOR, SIL, NPN	10226	3642
A21	POWER AMPLIFIER MODULE (A21) (4 PER UNIT)	10226	350L-4184
A21R1	RES, COMP, 100 ohm, 5%, 1/2 W	01121	RC20GF101J
A21R2-R3	RES, COMP, 51 ohm, 5%, 1/2 W	01121	RC20GF510J
A21R4	RES, COMP, 300 ohm, 5% 2 W	01121	RC42GF301J
A21R5	RES, COMP, SELECTED	01121	RC32
A21R6	RES, COMP, 300 ohm, 5% 2 W	01121	RC42GF301J
A21R7	RES, COMP, SELECTED	01121	RC32
A21R8	RES, COMP, 300 ohm, 5%, 2 W	01121	RC42GF301J
R21R9	RES, COMP, SELECTED	01121	RC32
A21R10	RES, COMP, 300 ohm, 5%, 2 W	01121	RC42GF301J
A21R11	RES, COMP, SELECTED	01121	RC32
A21R12-R15	RES, COMP, 150 ohm, 5%, 1/4 W	01121	RC07GF151J
A21R16-R19	RES, COMP, 150 ohm, 5%, 2 W	01121	RC42GF151J
A21R20-R31	RES, COMP, 18 ohm, 5%, 2 W	01121	RC42GF180J
A21R32-R33	RES, COMP, 51 ohm, 5%, 2 W	01121	RC42GF510J
A21R34	RES, COMP, 100 ohm, 5% 2 W	01121	RC42GF101J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A21R35-R38	RES, COMP, SELECTED	01121	RC07
A21R39	RES, W.W. 2 ohm, 10%, 2 W	75042	BWH-2
A21R40-R43	RES, COMP, 150 ohm, 5%, 1/4 W	01121	RC07GF151J
A21C1-C2	CAP, MICA, 18PF, 5%	09023	CM05ED180J03
A21C3-C6	CAP, MICA, 39PF, 5%	09023	CM05ED390J03
A21C7-C10	CAP, CER, 0.47UF, 50 VDCW	72982	8131-050-651-474Z
A21C11-C14	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21C15-C26	CAP, MICA, 39PF, 5%	09023	CM05ED390J03
A21C27-C30	CAP, DER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21C31-34	CAP, CER 0.47UF, 50 VDCW	72982	8131-050-651-474Z
A21C35-C37	CAP, MICA, 15PF, 5%	09023	CM05ED150J03
A21C38-C39	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21L1-L4	CHOKE, RF, .47UH, 10%	99800	MS18130-4
A21L5-L8	CHOKE, RF, 150UH, 10%	99800	MS75052-7
A21L9-L12	CHOKE, RF, 100UH, 10%	99800	MS91189-37
A21T1	TRANSFORMER	10226	
A21T2	TRANSFORMER	10226	
A21T3	TRANSFORMER	10226	
A21T4	TRANSFORMER	10226	
A21T5	TRANSFORMER	10226	
A21T6	TRANSFORMER	10226	
A21T7	TRANSFORMER	10226	
A21T8	TRANSFORMER	10226	
A21T9	TRANSFORMER	10226	
A21T10	TRANSFORMER	10226	
A21T11	TRANSFORMER	10226	
A21Q1-Q4	TRANSISTOR, SIL, NPN	10226	5754
A23	COMBINER MODULE (A23)	10226	350L-4186
A23R1-R2	RES, W.W., 100 ohm, 1%, 15 W	19647	MP312-100
A23R3	RES. W.W., 50 ohm, 1%, 15 W	19547	MP312-50
A23C1-C2	CAP, MICA, 10PF, 5%	09023	CM05ED100J03
A23C3-C4	CAP, MICA, 3Pf, 5%	09023	CM05ED030J03
A23C5	CAP, MICA, 30PF, 5%	09023	CM05ED300J03
A23C6	CAP, MICA, 10Pf, 5%	09023	CM05ED100J03
A23T1-T2	TRANSFORMER	10226	
A23T3	TRANSFORMER	10226	
A23T4	TRANSFORMER	10226	
A12	RF VOLTMETER MODULE (A12)	10226	350L-4182
A12R1-R4	RES, COMP, 2.7K, 5% 1/2 W	75042	RC20GF272J
A12R5	RES, COMP, 390 ohm, 5%, 1/4 W	01121	RC07GF391J
A12R6	RES, COMP, 2K ohm, 5%, 1/4 W	01121	RC07GF202J
A12R7	POT, VERTICAL, MTG. 1K	32997	3389T-1-102
A12R8	RES, COMP, 22 ohm, 5% 1/4 W	01121	RC07GF220J

Table 7-1. Replacement Parts List. (Cont.)

REF. DESIG.	DESCRIPTION	MFR. CODE	PART NO.
A12C1	CAP, CER, 0.033UF, 50 VDCW	72982	8121-050-651-333Z
A12C2	CAP, CER, 0.1UF, 50 VDCW	72982	8121-050-651-104Z
A21CR1	DIODE	28480	HPA-5082-2800

Table 7-2. Glossary of Abbreviations

AMP	AMPERES	PF	PICOFARADS
AMPL	AMPLIFIER	POT	POTENTIOMETER
BKT	BRACKET	REF	REFERENCE
CAP	CAPACITOR	RES	RESISTOR
CER	CERAMIC	SIL	SILICON
COMP	COMPOSITION CARBON	UF	MICROFARADS
		V	VOLTS
DPDT	DOUBLE-POLE DOUBLE THROW	VAR	VARIABLE
		VDCW	DC WORKING VOLTS
IN	INCHES	W	WATTS
K	KILOHMS	WW	WIRE WOUND
MTG	MOUNTING		
MW	MILLIWATTS		

Table 7-3. List of Manufacturers.

FEDERAL SUPPLY CODE NUMBER	MANUFACTURER	ADDRESS
01121	Allen-Bradley Co.	Milwaukee, WI.
04713	Motorola, Inc. Semiconductor Prod. Div.	Phoenix, AZ.
09023	Cornell-Dubilier Electronics	Sanford, N.C.
10226	ELECTRONIC NAVIGATION INDUSTRIES, INC.	Rochester, N.Y.
12715	American Megnetics, Corp.	Carterville, IL.
13511	Amphenol Corp. Inc.	Los Gatos, CA.
14604	Elmwood Sensors, Inc.	Cranston, R.I.
16299	Corning Glass	Raleigh, N. C.
19647	Caddock Electronics, Inc.	Riverside, CA.
22753	U I D Electronics Corp.	Hollywood, FL.
28480	Hewlett Packard Co.	Palo Alto, CA.
31356	J-B-T Instruments Inc.	New Haven, CT.
32171	Modutec, Inc.	Norwalk, CT.
32997	Bourns, Inc.	Riverside, CA.
49956	Raytheon Co.	Lexington, MA.
56289	Sprague Electric Co.	N. Adams, MA.
71785	Cinch Mfg. Co.	Elk Grove Village, IL.
72619	Dialight Corp.	Brooklyn, N.Y.
72982	Erie Technological Products, Inc.	Erie, PA.
75042	I R C Div. of TRW Inc.	Philadelphia, PA.
75915	Littlefuse, Inc.	Des Plaines, IL.
79089	R C A	Harrison, N. Y.
82877	Rotron, Inc.	Woodstock, N. Y.
99800	Delevan Electronics Corp.	E. Aurora, N. Y.

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